Artificial Intelligence in Dentistry: Chances and Challenges

Year: 2020 | Citations: 765 | Authors: F. Schwendicke, W. Samek, J. Krois

Abstract

The term “artificial intelligence” (AI) refers to the idea of machines being capable of performing human tasks. A subdomain of AI is machine learning (ML), which “learns” intrinsic statistical patterns in data to eventually cast predictions on unseen data. Deep learning is a ML technique using multi-layer mathematical operations for learning and inferring on complex data like imagery. This succinct narrative review describes the application, limitations and possible future of AI-based dental diagnostics, treatment planning, and conduct, for example, image analysis, prediction making, record keeping, as well as dental research and discovery. AI-based applications will streamline care, relieving the dental workforce from laborious routine tasks, increasing health at lower costs for a broader population, and eventually facilitate personalized, predictive, preventive, and participatory dentistry. However, AI solutions have not by large entered routine dental practice, mainly due to 1) limited data availability, accessibility, structure, and comprehensiveness, 2) lacking methodological rigor and standards in their development, 3) and practical questions around the value and usefulness of these solutions, but also ethics and responsibility. Any AI application in dentistry should demonstrate tangible value by, for example, improving access to and quality of care, increasing efficiency and safety of services, empowering and enabling patients, supporting medical research, or increasing sustainability. Individual privacy, rights, and autonomy need to be put front and center; a shift from centralized to distributed/federated learning may address this while improving scalability and robustness. Lastly, trustworthiness into, and generalizability of, dental AI solutions need to be guaranteed; the implementation of continuous human oversight and standards grounded in evidence-based dentistry should be expected. Methods to visualize, interpret, and explain the logic behind AI solutions will contribute (“explainable AI”). Dental education will need to accompany the introduction of clinical AI solutions by fostering digital literacy in the future dental workforce.